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ABSTRACT

Data from a statewide screening of Tennessee Head Start children on the Developmental Test of Visual-Motor Integration (VMI) are analyzed in this report for two purposes: to determine whether sex, race, and residence have a significant influence on visual motor development as measured by the VMI, and to develop VMI norms for the Tennessee Head Start population. An initial review of literature relating to the study of norms and variable effects focuses on effects of gender, race and place of residence upon visual motor ability, and on various measurement scales. This is followed by a description of methods and procedures utilized in the present study. The VMI was administered individually to Tennessee Head Start children. Scores for 3,766 children aged 4 and 5 were analyzed for significant differences on three variables--gender, race (black/white), and residential location (rural, urban, mixed urban-rural)--by a 3-way analysis of variance. Homegeneity of variance for all levels of the three variables was determined. Results indicated (1) no significant differences between male and female scores, (2) significantly higher scores by white children than black children regardless of residential location, and (3) no significant differences between urban and rural children's mean scores, though both urban and rural children scored higher than children from mixed areas. General differences between norms generated by this study and the standardized norms are discussed and directions for further research identified. (CM)

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A FACTORIAL ANALYSIS OF VARIANCE AND RESULTING NORM TABLES FOR TENNESSEE HEAD START CHILDREN BASED ON THE DEVELOPMENTAL TEST OF VISUAL-MOTOR INTEGRATION

Barbara A. Nye

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CHAPTER I

INTRODUCTION

Background

One of the dimensions on which children are known to differ is perceptual functioning. Historically, perceptual development was studied in laboratory settings. In more recent years, however, field experiments and field studies have played an increasingly important role in developing an understanding of perception and related phenomena, such as visual-motor integration. Past studies revolved around both brain-injured children (Strauss and Lehtinen, 1947; Strauss and Kephart, 1955) and normal children (Cohen, 1969; Beck and Talkington, 1970; Keim, 1970; Solan and Seiderman, 1970; Wise, Jones, and Renz, 1972; Busse, Ree, Gutride, and Alexander, 1972). An increasing interest is developing in studying perceptual functioning as it relates to behavioral and academic achievement.

In the area of perceptual development, a monumental amount of research and speculation is accumulating. Questions of how to study perceptual functioning and how perceptual skills relate to academic abilities are continually debated. Mann (1970) discussed perceptual training as an artifically isolated set of behaviors and discouraged parents and professionals from using such terminology as "perceptual handicap," "perceptual-motor delay," and the like. Cohen (1969) also

questioned the motives of perceptual-motor assessment as presently performed and interpreted.

Other researchers, however, have called for increased emphasis on locating perceptual-motor lags early for remediation. Solan and Seiderman (1970) concluded that a child with a perceptual-motor delay could experience difficulty in coping with problems in general at the primary level. Also, the delay if not remediated could generalize, and children could lag developmentally (Ames, 1969).

Many studies have attempted to correlate perceptual dysfunction with reading skills (Cohen, 1969), readiness to read (Keogh, 1963 and Keim, 1970) and school achievement (Keogh and Smith, 1967). Other tests, such as the Developmental Test of Visual Perception (Maslow, Frostig, Leferew, and Whittlesey, 1964), the Illinois Test of Psycholinguistic Abilities (Kirk and McCarthy, 1961), the Gates Reading Readiness Test (Gates, 1940), and the Murfreesboro Readiness Test (Klaus, 1969), have included visual-perception tasks because of their obtained correlations with academic performance.

Definition of Visual Motor Integration

After a review of the literature, the first and most difficult problem is to isolate the dimensions of perceptual functioning of visual-motor integration and to develop operational definitions. Perceptual functioning according to Strauss and Lehtinen (1947) is an intermediate activity between sensation and thought. Piaget (1957; Piaget and Inhelder, 1959) described perception as a mode of adaptation

or contact with the environment, which involves only the most immediate possible knowledge of an object being present in the sensorial field. Anything beyond this level would involve the mediation of higher level cognitive processes. Miller, Galanter, and Pribram (1960) described perception as that which occurs between cognition and action. Gibson (1966) also contended that information is manipulated. Bruner (1957) described perception as an end product of categorization. Finally Kephart (1960) discussed motoric behavior as a closed system that acts before we are ever conscious that we have perceived. He emphasized the nature of a feedback component as supported by Miller et al. (1960) on the basis of neurological evidence.

If there is any consensus among these investigators, it is that perception is an active and complex process. Perception as related to visual-motor integration or eye-hand coordination as it is sometimes referred to will be defined for the purposes of this study as a process of organizing, coding, and interpreting raw, sensory input or experience. . . . (McCandless, Evans, 1973, p. 190). The lack of this ability is termed visual-perception deficit, which describes malfunctions in the processing system due to organic impairment, developmental lag, lack of learning or genetic inheritance (Cohen, 1969, p. 8). Visual-motor integration is the expressed ability to coordinate the visual and motoric systems simultaneously in order to complete a variety of tasks, such as form copying. Form copying involves simultaneous coordination of the eye and hand.

One test that has been developed to assess eye-hand coordination by the use of geometric form reproduction is the Developmental Test of

Visual-Motor Integration (VMI) (Beery and Buktenica, 1967). The test consists of 24 geometric forms arranged in order of increasing difficulty to be reproduced with paper and pencil. The VMI is designed primarily for use in preschool and early grades (Buktenica, 1968, p. 35). It measures eye-hand coordination, which is the degree to which visual perception and motor ability integrate in young children.

Beery (1967) has cited relationships of scores on reproduction of geometric forms to both I.Q. scores and to academic achievement scores. Correlations between I.Q. scores and the Metropolitan Achievement Reading Readiness Tests (1971) have ranged from .50 to .70 (Small, 1958 and Leton, 1963). Correlations between form copying and reading achievement have ranged from .40 to .60 (Robinson, 1958; Potter, 1949; and Lowder, 1956). Although form copying tests do not assess auditory abilities and other factors influencing reading success, a rather large percentage of the total variance in reading achievement may be explained by form reproduction tests. According to Beery (1967, p. 18), 36 percent of the variance is explained by copying tests.

Correlation findings based on the VMI were also presented in the monograph (Beery, 1967). Correlation coefficients of .58 to .74 were reported between the VMI and five subtests of the Frostig (Frostig and Horne, 1964). Correlation coefficients between the VMI and nine subtests of the Illinois Test of Psycholinguistic Abilities (Kirk, 1968) ranged from .20 to .81. Correlation coefficients reported with chronological age and with mental age based on the VMI are .32 and .59 respectively.

From the correlation data reviewed above Beery (1967) stated:

> It appears that the VMI correlates well with first-grade achievement, as compared with other group tests of intellectual and perceptual abilities. This is especially the case among lower socioeconomic groups. [It may be inferred that most children of the middle socioeconomic group find a wealth of toys and activities related to visual-motor readiness skills within their preschool environments, so that their levels of development in the visual-motor area are relatively similar, in contrast to wider variations of development among lower socioeconomic children]. (p. 39)

The VMI was standardized on a population of 1,039 subjects of average intelligence from a variety of socioeconomic groups in Illinois (see Appendix, Table A-1). Various measures of test-retest reliability yielded correlation coefficients ranging from .83 to .87 for all age levels. The correlation between chronological age and the number of forms correct on the VMI was .89 (Buktenica, 1968, p. 36). Age norms have been developed for children age two to fifteen by means of a standardization sample and previous Geometric Form Reproduction (GFR) tests.

Information in the Buros' Seventh Mental Measurements Yearbook (1972) described the characteristics of the standardization group. The age levels for the suburban group were fairly well represented, but no single category contained over thirty-two children in either the rural or urban group. Over one-half (57 percent) were children from suburban schools, and 26 and 17 percent were from urban and rural schools, respectively. From information in the technical report, standardization is adequate for only ages five to thirteen and only for children from suburban schools (Chissom, 1972, p. 868). Further

information reported by Chissom concerning the VMI is summarized as follows:

> The authors of the VMI have devised a test that is good for group administration and that will detect children with problems in visual motor integration. It has been constructed according to sound theoretical consideration and methodological procedures, and the developmental sequence of items holds promise for an indepth assessment of this area of school learning problems. Provided more information is made available about reliability and predictive validity for both the short and long forms and a more representative standardization is accomplished, this test should be substantially more useful than similar tests employing geometric form reproduction items. (p. 868)

Statement of the Problem

In order to isolate and operationalize one aspect of perception (visual-motor integration) for study, the data from a state-wide screening of Head Start children in Tennessee were analyzed. Children in Head Start in Tennessee were screened on the Developmental Test of Visual-Motor Integration, the VMI (Beery and Buktenica, 1967).

One purpose of this study was to investigate the applicability of the norms established for the VMI by Buktenica (Beery, 1967, p. 66) as applied to a Head Start sample (see Appendix, Table A-2). The present study has accomplished this by generating norms based on the Head Start screening to supplement existing norms. Without additional information, inappropriate pass, fail criteria might be used in assessing the abilities of Head Start children.

The norms generated by this study seemed to be more applicable to the Head Start population in general and especially in Tennessee.

This could be due to the fact that Buktenica's standardization sample (see Appendix, Table A-1) contained few preschool or lower-socioeconomic children. The norms generated by the present study were lower than those previously established (see Appendix, Table A-2).

The inference that the present norms could be inappropriate stemmed from the definition of a standardization sample. The sample of examinees must be representative of the group for whom the test is intended. This representative sample should be alike in every manner possible including such characteristics as sex, age, race, family income, place of residence, and other significant variables (Aiken, 1974). In order to be useful for interpreting an examinee's test score, the norms must be appropriate. A primary reason for using norm tables is to determine one's standing in the group being tested. Thus, the norms must be developed from a sample very similar to the group to which the norms are applied. Often, local norms must be developed for determining the standing of an individual's score as compared to group scores.

Extensive use is being made of the VMI in evaluating Head Start children at the present time. The VMI has been administered in Tennessee and three other southern states to virtually all Head Start children (1975-76). The present study seemed necessary, since established norm data may be generally inadequate for such children. One reason for this possible inadequacy of the norms in evaluating Tennessee Head Start children, as discussed earlier, is that a large percentage of these children are rural preschoolers with a limited number of children being urban preschoolers. Existing norm data were established primarily on older suburban children, and particularly

the number of preschool children present in the standardization sample was small.

There were no urban or rural three and four year olds in the standardization sample, and there were 16, 75, and 113 urban, suburban and rural five year olds respectively (see Appendix, Table A-1). With the characteristics of the standardization sample in mind, it would be inappropriate to judge Head Start children as passing or failing based on the established norms. A preschool standardization sample, which included a more normal distribution of such variables as family income and parental education level, etc., would provide the best norm data. Since the ideal sample was not available, norming will be investigated in the Tennessee Head Start sample to which the norms were applied.

Another factor, which could affect whether the norms established by Buktenica were inappropriate for Head Start children, is the income level of Head Start families. The level of family income is substantially lower in the Head Start sample than in the general population.

The present study determined what percentage of these children were passing or failing based on the established norms, and compared the norms to the norms generated by the present study. This study was not concerned with drawing conclusions from the relative percentages of passes or fails from the established or developed norms based on the characteristics of the population. An additional sample of children with more normally distributed socioeconomic backgrounds and parental education levels would be necessary for totally adequate standardization.

Influence of Sex, Race, and Place of Residence

Another objective of this study was to determine whether significant differences in scores on the VMI existed between groups as a result of sex, race, or place of residence. Resulting norm tables have taken these variables into account. The optimum time to study the questions of variable influence is the period of early childhood. After this time, differential practice and motivational concerns further interrupt and complicate the findings. Even among children at the preschool level, important differences in interests and abilities are evident. Differences due to these influences and variables such as sex, race, and place of residence, however, are usually not as great among preschoolers as they are at later ages.

Early childhood is an especially appropriate time to investigate the existence of significant differences based on gender, race, and residential location. By tracing these differences to the earliest age possible, there is greater likelihood of ascertaining their origin. Also, if intervention to alleviate such differences is warranted, childhood is again the time to undertake such remediation. Since this sample was substantially larger and more homogeneous than previous preschool groups available for study, the variables such as income and education level of the parents were also somewhat controlled. Thus, further justification for the investigation of these variable differences was provided.

The persistence of individual differences and specific abilities are areas in which only limited research has been completed. Intelligence measurement in general has been most widely discussed, but specific ability measures, such as visual-motor integration, have scarcely begun to be studied. Implications from this study and others would provide a basis from which to start.

One of the questions which consistently appears in discussions of tests results is whether there are significant differences between males and females in visual-motor development. Another frequently occurring question concerns differences due to ethnic or racial origin. A third area which has had little previous investigation in terms of visual-motor functioning is that of influence of residential location. Do urban children have more or fewer visual-motor deficits as compared with rural children?

Urban areas are usually thought of as cities or towns, and rural areas are those locations not in cities or towns but in the country. In order to establish operational definitions for the classification of counties for the present study, the U.S. Bureau of the Census, Census of Population 1970 Detailed Characteristics, Final Report (1973) was consulted. The following excerpt from this report defines urban and rural residence criteria.

> Definitions—The urban population comprises all persons living in urbanized areas [an urbanized area, generally, consists of at least one city of 50,000 inhabitants or more in 1970 and the surrounding closely settled area that meets certain criteria of population density or land use], and in places of 2,500 inhabitants or more outside urbanized areas. More specifically, the urban

> population consists of all persons living in (a) places of 2,500 inhabitants or more incorporated as cities, villages, boroughs [except Alaska], and towns [except in the New England States, New York and Wisconsin], but excluding those persons living in the rural portions of extended cities [Extended cities are so designated because they have one or more large portions (normally at the boundary of the city) with relatively low population density. These portions are classified as rural, and the residents are not included in the urban population.] (b) unincorporated places of 2,500 inhabitants or more; and (c) other territory included in urbanized areas. The population not classified as urban constitutes the rural population.

This report provides information by state and county based on the land area and population density. Counties listed as greater than 65 percent urban and counties listed as less than 35 percent urban were used as a basis to classify residential location as either urban or rural respectively. The residence classification of children classified as urban or rural for the purpose of this study was based on the county information provided in the 1970 census (see Appendix, Table A-3).

In order to establish an operational definition for the analysis of residential location, a cut-off point for the percentage of urban population by county was established as 65 percent as stated above. This percent was used to insure that the majority of the county's residents were in fact in the service area of a city of 50,000 or resided in a city, village, borough, or town of 2,500 or more. According to the 1970 U.S. Census Report (1973) of the total Tennessee population, only 37.9 percent live in cities of 50,000 or more and 20.9 percent live in communities between 2,500 and 50,000 inhabitants.

Of the total Tennessee population, 38.1 percent live in communities of less than 1,000; 41.2 percent live in areas of less than 2,500 people; and 61.3 percent live in areas having less than 50,000 inhabitants. In areas such as these, Head Start recruitment criteria specify serving rural children as a priority. Counties having less than 35 percent of their population residing in urban areas were designated as rural. Although Tennessee has a large percentage of rural counties, in order to avoid misclassification of children as rural, all children screened residing in counties of greater than 35 percent urban but less than 65 percent urban were classified as mixed urban-rural and analyzed separately. The Tennessee Head Start sample county classification information is provided in the Appendix (Table A-3).

The studies of visual-motor integrative ability in the literature have been concerned with variation due to gender, race, location, and other variables. Few previous studies, however, have looked for differences due to any of these variables at the preschool level and none have investigated a sample of this size. In terms of variable influence, the hypotheses of this study were:

1. There was no difference between the average performance of males as compared with the average performance of females on the Developmental Test of Visual-Motor Integration.

2. There was no difference in average performance of children by race (black, white) on the Developmental Test of Visual-Motor Integration.

3. There was no difference between the average performance of urban and rural children on the Developmental Test of Visual-Motor Integration.

No hypothesis concerning the norms generated in the present study in comparison with Buktenica's norms was stated, since only one attempt at standardization of the VMI had been made. Also, it would be inappropriate to base a hypothesis on studies of children in general, who are not similar either in income, place of residence, or other possible significant factors.

CHAPTER II

REVIEW OF THE LITERATURE

The survey of the literature relating to the study of norms and variable effects is divided into two parts. Visual and motoric system development and the justification of geometric form reproduction (GFR) tests comprise section one. The following section reviews the literature pertinent to the investigation of the effects of gender, race, and place of residence upon visual-motor ability. Only one of the research studies reviewed was conducted using the VMI for measurement; however, all the studies relate to eye-hand, visual-motor, or fine-motor tasks.

Visual and Motoric System Development

Many scales attempt to isolate or regiment behavior into separate parts. As a result, interactions of the parts of behavior may be missed. Visual functioning and motor functioning are two behavior systems which integrate. This integration is an important indicator of normal development. Malfunctioning may be indicated upon measurement in terms of integrative capacity as opposed to isolated parts of behavior. Geometric form reproduction is a measure of visual-motor integration and may be correlated with a lack of functional organization resulting from either insufficient development or from neurological impairment (Beery, 1967, p. 8).

Vision functions independently in the first few weeks of the infant's life in terms of gross ability to discriminate. The development of the visual process progresses through many stages. Three dimensional forms are perceived by infants and young toddlers; however, the relationships between objects and forms are not perceived until after the fifteenth month. Form is the common basis for matching objects until age three, when color cues become the most important from about age three to age six. Form again becomes dominant thereafter (Beery, 1967, p. 9).

Motor development follows patterns of gross to fine motor control with the finger activity being one of the last skills to develop. Halverson (1931) cited ten stages of infant prehension. Stage ten indicates that a child by 52 weeks can seize an object without resting his hand on the table. Picking up a crayon or pencil and scribbling occurs at about this time (Griffiths, 1954).

Several researchers have addressed the development of visual-motor integration or eye-hand coordination. Piaget (1952) found that during infancy the child begins to coordinate particular sensory modalities. He reported that the child begins to look at what he listens to and touches. Thus, the motor activity can be directed by auditory, visual, or tactile cues. Vereecken (1961) has also described the close correlation of eye and hand activities required to reproduce geometric forms. This explains why children can scribble before they can imitate or reproduce forms. Undifferentiated scribbling requires little or no coordination of the visual-motor systems.

Visual-motor integration is necessary to later cognitive growth. Piaget discussed sensory-motor experience as a basis for later development (Piaget, 1952). Bruner (1971, p. 55), in his discussion of information processing, indicated perceptual organization begins with enactive (motoric) behaviors.

Visual-motor integration is a function of motor and visual or eye-hand activity development. Along with these skills, kinesthetic sense, which furnishes information about position and movement, is important. Also, tactual sense of pressure plays a primary role in the integration of these systems. Visual-motor integration, however, may not be functioning adequately even if component systems operate well independently. Coordination of these systems depends upon the development of interaction of the systems mentioned.

According to Kephart (1960), the majority of form reproduction failures may result from integrative problems. He stated that visual and motor systems can and do often develop and function independently. Vereecken (1961) also reported that failures in geometric form reproduction are not merely a matter of motor technique.

There is research to support GFR as a means to identify visual-motor deficits (Beery, 1967, p. 24). Visual-motor integration problems may result from neurological or developmental etiologies. This organizational impairment in young children may be due to inadequate experience of other causes.

The degree to which sensory-motor functions develop and integrate may partly determine whether intellectual potential is reached;

therefore, visual-motor integration as an indicator of perceptual development is of special importance. Reproduction of geometric forms provides a useful measure of visual-motor integration (Beery, 1967, p. 20).

Variables Affecting Performance on Visual-Motor Integration Tests

Sex

One means of studying visual-motor development concerns the investigation of variables which may affect functioning. Gender, race, and residence location are the variables investigated in this study. Investigations of motor ability in young children by Goodenough and Smart (1935) questioned the existence of sex differences. Their sample consisted of 154 children attending nursery school and kindergarten at the University of Minnesota. The children were given a series of brief motor ability tests at annual intervals. A variety of fine and gross motor tests were administered.

Boys and girls showed very little difference on mean scores with almost complete overlapping of distributions. In reaction-time tests, the boys surpassed the girls at all age levels but with only small differences. The girls were slightly superior to the boys in needle threading and the three hole test. Only a possible superiority of the boys was found on the tapping tests, but this was not reliably established.

Several tests have been developed to assess integrative ability based on form reproduction. The Bender Visual-Motor Gestalt Test (1938) is more directly related to the VMI. Several forms used in the Bender are found on the VMI; however, they are not ordered the same. For example, the fifth Bender form is the tenth on the VMI, and the tenth on the VMI is the first on the Bender. These differences explain why the Bender is more difficult for preschool children from a developmental standpoint. Since both tests measure visual-motor integration and can be used with young children, the review of the literature most pertinent to the present study discusses investigations primarily on the Bender.

Although there is more research in the literature on the Bender, other tests containing many similarities to the VMI have been developed. For example, The Rutgers Drawing Test (1952-1964) is a nonverbal copying test used to assess such abilities as perception of form and space, analysis of design in reproduction, and motor coordination. Form A of the test requires a child to copy a series of fourteen, two-dimensional geometric and bilaterally symmetrical designs, which increase in complexity and difficulty. The standardization sample for Form A of the Rutgers included 1,428 children between the ages of four and seven. According to Buros (1972, pp. 830-31), however, the standardization sample is inadequately described. There is also no information provided as to the reliability data for Form A.

Several previous studies of the phenomenon of visual-motor integration have stemmed from the Bender-Gestalt Test (1938). Correlational studies of the Bender with readiness tests (Koppitz, 1964)

have produced findings ranging from .59 to .68. Other researchers (Taylor and Schulberg, 1963) used the Bender as a rough measure of intelligence with abnormal children showing significant correlations of .34 to .77 between intelligence and test performance.

Several studies have examined sex differences on the Bender-Gestalt. Sex differences in Bender protocols have been explored with adult populations with no significant differences being found. A study by Koppitz (1964) mentioned that girls appear to mature somewhat earlier than boys in visual perception, but there were no significant sex differences at any age level (Fielder and Schmidt, 1969).

Developmental changes on the Bender-Gestalt were investigated by Smith and Keogh (1963). One hundred and seventeen public school children were administered the test in kindergarten and grades two and three. No significant differences in performance between boys and girls were reported for any grade level. However, the data showed that the Bender could be used as a measure of developmental differences at the kindergarten-primary level.

Studies cited by Dierks and Cushna (1969) also indicated no sex differences on the Bender. Most of those mentioned, however, dealt with studies on adults, such as Pascal and Suttell (1951); and Abramson, Waxenberg, Levine, Kaufman, and Kornesky (1955). Dierks' and Cushna's sample consisted of 478 children evaluated at the Child Development Clinic at the University of Iowa from 1964 to 1967. One hundred thirty-six girls and 342 boys, ages 5.0 years to 16.7 years were examined. Preliminary findings showed that no sex differences

existed. Upon further study, however, sex was found to be a major influence even when the effects of maturation and diagnostic differences were extracted. This study is especially important, since some preschool children without any known organic or nonorganic deficits were tested. Ninety-seven of the children were not suffering from any impairment with or without known cause. Dierks and Cushna found opposite maturational sex differences than Koppitz (1964), and their findings were statistically significant. In their sample, it appeared that boys matured faster than girls on visual-motor performance. Since the total sample was constituted of some children with impairments, these findings may not prove applicable to the "normal" preschool population.

Another study on gender differences in Bender-Gestalt drawings was conducted by Bensberg (1952). Although differences were found, the sample was constituted of all mental retardates. In 1969, a nonclinic sample of 600 seven year old children were given the Bender-Gestalt and scored by the Koppitz (1964) system. Fielder and Schmidt (1969) found no significant differences due to gender when the mean raw scores were compared. All children were white and were randomly selected from the Maternal Infant Health Study population.

The Bender was administered to another sample group in 1974. Greenberg and Alshan (1974) were investigating perceptual-motor functioning among lower-class, black children. One hundred sixty black children in the fifth grade were tested. Among the other findings, sex differences were minimal.

Although the Bender has received the most attention in the area of gender difference study, Beck and Talkington (1970) reported on a training program with Head Start children using a different test. The study was not primarily concerned with sex differences, but the authors noted that no significant sex differences were observed on scores made on the Frostig Developmental Test of Visual Perception (1966) nor on the Peabody Picture Vocabulary Test (1959).

In a study by Shepard (1942) exploring differences between rural and urban children on nonverbal abilities, a variety of tests were administered. An incidental comparison was made between rural girls and urban boys. The mean scores reflected a less than three point difference for the sexes. This was not regarded as significant.

The study most directly related to the present study was conducted in Tennessee. In 1973, 612 kindergarten children were screened using the VMI and two other tests. Southworth (1973) investigated the possibilities of predicting reading difficulty in first grade based on scores made on brief perceptual-motor tests. The VMI was one of the predictor tests administered. No significant differences between boys and girls on scores for copying the geometric designs were found. Further findings of this study were that prediction of poor reading level can be measured to some extent by use of one perceptual-motor test, but that prediction can be improved by employing the findings of two such tests when making predictions (p. 67). Another interesting finding of Southworth's study was that the mean scores of the sample were about four months below norms established by Buktenica from the

standardization sample (Beery, 1967). Considering the review of the research on gender differences as affecting visual-motor performance, from 1935 to the present, and Southworth's (1973) study in particular, one must hypothesize that no significant differences would be found on mean score comparisons of boys and girls on the Beery, Bukterica Developmental Test of Visual-Motor Integration (1967).

Race

The Bender-Gestalt (1938) was administered and scored on the Koppitz (1964) system. The lower-class black children made more errors than the normative group. The deficiencies were particularly marked for the low-achievers. The high-achievers were close to the norm. Sex differences were minimal, although girls made more errors. Perceptual difficulties found in children in the Greenberg and Alshan (1974) study were diagnosed as nonorganic in etiology. Lack of experience with visual materials, insufficient use of verbal mediation, underlying anxiety, and emotional problems noted were cited as possible factors contributing to the findings.

In tests of motor abilities of blacks and whites, Rhodes (1937) concluded that there was little if any difference between the groups at any level of development as far as motor abilities are concerned. Rhodes discusses past investigations of race as a cause of difference in performance. Klineberg (1928) studied blacks and whites on performance tests, concluding that the tests measure primarily speed and differences between groups due to environmental training. The main conclusion

of the few studies in which racial differences in motor abilities have been explored is that blacks seem to be equal or superior to whites (Rhodes, 1937). The number of such studies have been small and according to Rhodes (1937) none have dealt with young children.

Joseph Moore (1942) compared black and white children on vocabulary and eye-hand coordination tests. No statistically reliable differences between these groups were found. The activities employed in the testing included walking the line, threading a needle, stylus tapping, and placing marbles in holes one at a time. The subjects in this study were drawn from private, public, and governmental nursery schools and kindergartens in Kentucky and Tennessee. There were 78 blacks and 82 whites in the sample ranging in age from 24 months to 77 months. Economic background ranged from very poor to very well-to-do.

According to Moore (1942), the results on the eye-hand coordination test showed that the superiority of the white group was not as marked on the eye-hand coordination test as on the vocabulary knowledge test. The black subjects were less variable on both tests, and there was marked superiority of the black children over the white children at the two youngest age groups on the visual-motor test. According to Moore, further investigation is needed to determine if the differences are due to sampling or to other factors not yet investigated among the groups. He also reported that the data indicated that the test employed for vocabulary measurement reflected cultural advantages favoring whites more so than the eye-hand coordination test, which was less influenced by specific environmental stimulation. The performance on the eye-hand test did not indicate conclusive race differences.

In a study by Stephenson (1968), results showed that race was a significant factor on subtests of the Illinois Test of Psycholinguistic Abilities (ITPA, 1968). For white children of the lower socioeconomic level, the low scores were Verbal Expression and Auditory Vocal Association, and for black children, scores were low on the same two subtests. Motor encoding surpassed verbal encoding for both groups.

Lesser, Fifer, and Clark (1965) concluded that ethnology is a highly significant factor acting upon levels as well as patterns of mental abilities. Their study focused on six and seven year old Chinese, Jewish, Black and Puerto Rican children. Further conclusions were drawn concerning the interaction of social class and ethnology. Significant effects on the level of mental abilities but not on the pattern of abilities were found. The effect of social class and mental ability was more pronounced in black children than in any other ethnic group according to this study.

Weaver and Weaver (1967), found that tests measuring visual and motor channels of disadvantaged black children usually produce higher scores than those measuring auditory and vocal channels. In contrast to other studies, an investigation by Stephenson and Gay (1972) on ITPA scores of black and white children did not support research stating that lower-class children are visual-motor and middle-class children are auditory-vocal oriented respectively. Both black and white children showed higher visual scores than auditory scores. Children of both races exhibited considerable intersubtest variability.

Past studies examining the effects of race on visual-motor performance provided little conclusive data to support whether blacks or whites scored higher on tests measuring visual-motor ability. Also, these studies offered limited control on extraneous variables such as income. The present study has provided additional data on race as a variable and due to the nature of the sample (Head Start children) some control over effects on VMI scores due to income and education level of the parents is provided. Also, a larger sample than those previously available for study was utilized.

Residence

In contrast to the number of investigations of gender and race differences as affecting visual-motor scores, a lengthy and detailed search of the literature in the area of the effects of place of residence proved somewhat fruitless. The only study which relates directly to this area concerned the measurement of rural and urban children on certain nonverbal abilities. This study was conducted by Eugene Shephard (1942). He hypothesized that children from diverse cultural groups may exhibit measurable differences due to a variety of environmental contacts determined by geographic location.

Five tests were given to rural elementary children in Kansas and urban children in New York City. The children were matched on occupational level of parents, chronological age, sex and place of birth (native or foreign). Over two hundred children took each test. Rural children were found to be statistically superior in mechanical ability

involving eye-hand coordination tasks. Urban children were found to be superior in verbal ability. Overall results of the study, however, indicated that assumptions of regional group superiority are unjustified in terms of intelligence.

With only one related study to investigate the effects of residence location on visual-motor development and findings in this study indicating no overall group differences in intelligence, one must conclude that differences based on residential location are nonexistent. Although the sample size was sufficient, and such variables as age, sex, education level of the parents, etc. were controlled, no specific mention is made of income control other than matching for occupation when possible. Matching for occupation in these diverse situations was not always possible, since urban and rural jobs differ in pay level and what is entailed. Also, the tests utilized were not specific measures of visual-motor integration as is the VMI.

With the characteristics of these studies in mind (general intellectual measures, limited sample sizes, varying socioeconomic and parental education levels, clinic groups, nonspecific visual-motor integration measures, etc.), it would be of value to examine gender, race and locational differences among groups as possible factors having affects on visual-motor performance. Also, the sample available for study offered control in terms of extraneous variables, such as income, which are not controlled in previous studies.

CHAPTER III

METHODS AND PROCEDURES

Data Collection

The sample available for this study consisted of 4,209 Head Start children in Tennessee. There were 1,992 boys and 2,217 girls age three to six. Ninety-two additional children were screened; however, their scores were omitted due to the lack of necessary information on the children. The sample was composed of Tennessee Head Start children who participated in a state-wide screening conducted by the Bill Wilkerson Speech and Hearing Center in the Fall of 1975. The sample is presented in the Appendix (Table A-4) in terms of Programs participating in the screening by county and by number of children screened and is also described by age, sex, race, and residential location (see Appendix, Table A-5). Only the four and five year old children's scores (3766) were analyzed in the present study.

Data for 22 programs are listed. One Head Start Program in the state did not participate in the screening. Memphis-Shelby County Head Start children were screened on a different battery of tests by a different screening provider. Data from the Knoxville City Program were obtained from the local Program, although the children were not screened by the Bill Wilkerson teams. The screeners in this Program were teachers, who were trained to administer the VMI and were supervised by the Program psychologist. Data were accepted based on

the .98 inter-rater-reliability quotient reported by Beery (1967, p. 34), and the results of the inter-rater-reliability test conducted for this study.

The screeners in all Head Start Programs, other than in the Knoxville City Program, were graduate students in audiology and speech pathology working toward either the Master's or doctoral degree at Vanderbilt University with the exception of one screener. Approximately 60 children in one Program were screened by a graduate student at the Master's level from the University of Tennessee in the Department of Child and Family Studies. All screeners received training in the administration and scoring of the VMI. Supervisors accompanied the screening teams to local program screening sites, and they also screened children. The supervisors had all received their Certificate of Clinical Competence from the American Speech and Hearing Association, and they had also received training in the administration and scoring of the VMI.

Although Beery (1967, p. 34), reported a .98 inter-rater-reliability quotient, an inter-rater-reliability test was conducted for the present study. Approximately 30 graduate students were administering and scoring the VMI in 22 different programs. Seventy-five test forms containing a total of 656 drawings were scored independently by four testers. The two supervisors, who participated in the Tennessee screening, also participated in the inter-rater-reliability study. The results of this study are displayed in the Appendix (Table A-6).

The inter-rater-reliability quotients for the testers ranged from .89 to .91, and the average inter-rater-reliability quotient for the testers was .90. The supervisors reliability quotient was .90. The average inter-rater-reliability quotient consisting of all possible pairings of testers and supervisors was .90.

Administration and Scoring Procedure for the VMI

The children were tested individually; although, the test can be administered to groups of children (Beery, 1967). Each child had a pencil placed in front of him to pick up. This was to determine handedness, which was noted on the Record Form. Children were not forced to take the test, and most responded instantaneously. If a child did not take his turn, another child was given his turn, and later the nonresponding child was given another chance. If the child never took the test, the recording form was marked unable to test.

Pass/fail criteria consisted of each child being asked to copy the drawings one at a time until he had attempted unsuccessfully to copy three consecutive figures. The test was then stopped and the raw score (number of correct forms copied) recorded.

An additional factor to be accounted for in analyzing the data was the presence of handicapped children in the sample. Head Start was mandated to serve 10 percent handicapped children. The children professionally diagnosed as having handicapped conditions affecting VMI performance were deleted from the sample under study.

Handicapping conditions considered as automatically affecting performance or not appropriate for a standardization study were noncorrectable visual deficits, deafness, arthritis, mental retardation, cerebral palsy, and other physical and neurological impairments. This does not suggest that all of these children failed the test. Many were found to be gifted on this and other tests. Diagnosed, nonsevere, speech and language impairments were not considered handicaps requiring omission of children's scores, since these problems would be found in most preschool populations. The number of handicapped children's scores omitted was 197.

Research Design

The data were analyzed to develop norm tables taking into account the variables, gender, race, and residential location. All data were transcribed to coding sheets and then key punched on 80 column computer cards. The key punched information included age, sex, race, county of residence, and VMI raw score.

Four and five year old VMI mean scores were analyzed for significant differences on each variable (factor) by a three-way analysis of variance procedure. The factors, sex, race, and residential location were examined. The sample was investigated for interaction among factors prior to independent variable investigation. If the interaction between factors was found to be significant; a follow-up investigation (a test of simple main effects) was made, comparing at each age level, the various levels of the other factors (e.g., sex, race,

and residence). If there was no interaction between factors, but a particular individual factor (sex, race, residence) was found to have a significant main effect, then a multiple comparison test, the Scheffé (Kirk, 1968, pp. 90-91) was conducted, when the factor had more than two levels.

Prior to the analysis of variance, factor levels having unequal sample sizes were tested for homogeneity of variance (Smith, 1977). The Bartlett chi square test (Namboodiri, Carter, and Blalock, Jr., 1975, p. 253) was used to test the null hypothesis, which assumed equal variances among factor levels.

The dependent variable analyzed was the VMI test scores of 2,709 four year olds and 1,057 five year olds. The analysis began with each total age group's scores in order to determine if there was any significant interaction among the three independent variables utilizing the relatively large cell sizes. Follow-up investigations were made when significant differences were found.

The three independent variables (factors) investigated were:

1. Sex with two levels
    a. female
    b. male
2. Race with two levels
    a. white
    b. black

3. Residential location with three levels
   a. rural
   b. urban
   c. mixed urban-rural.

This investigation consisted of a 2 × 2 × 3 factorial analysis of variance.

As discussed in Chapter I, exact residential location was determined by classifying the county in which a child lived into one of three categories based on criteria. Since no other directly applicable classification system had been used with such data, the system was developed by the researcher using information from the 1970 Census Report (U.S. Bureau of the Census, 1973). Rural counties are those with 35 percent or less of their population residing in urban areas. These are communities of usually less than 1,000 in population. Urban counties are those counties where 65 percent or greater of the residents live in a service area of a city of 50,000 or more or reside in an area of 2,500 or more. The third category or residence was mixed urban-rural and included counties whose population areas were greater than 35 percent urban but less than 65 percent urban.

Assumption of Homogeneity of Variance

The statistical technique used to test the null hypothesis was a three-way analysis of variance or factorial ANOVA. The hypothesis investigated related to the presence or absence of a consistent, identifiable influence on VMI test scores as a result of sex, race, and/or place of residence.

Inferences in factorial ANOVA procedures are based on the F statistic. One of the basic assumptions underlying the legitimate interpretation of the F statistic in linear ANOVA models is that the variances of the dependent variable (VMI score by age) be homogeneous for each independent variable or factor level, sex (male, female), race (white, black), residential location (rural, urban, other). If the cell sizes of each level of a factor are equal, the F test is robust even though the variances of the levels of a factor differ. In this study, the cell sizes were not equal. Thus, the Bartlett chi square test (Namboodiri, Carter and Blalock, Jr., 1975, p. 253) was applied to determine the legitimacy of the assumption of homogeneity of variance between the levels of each factor. The results of this analysis are presented in Chapter IV.

Three-Way Analysis of Variance Procedure

The factorial ANOVA procedure in this study answered five research questions. The first three questions can be simply stated:

1. Did the factor, sex, independently affect the VMI mean scores significantly at each or any age level (4, 5)?
2. Did the factor, race, independently effect the VMI mean scores significantly at each or any age level (4, 5)?
3. Did the factor, residential location, independently affect the VMI mean score, significantly at each or any age level (4, 5)?

These questions concerned the main effect of individual independent variables.

The fourth and fifth research questions, while often less obvious, must logically precede the investigation of main effects. The questions involved the investigation of interaction among the factors. The fourth and fifth questions considered were:

4. Was there any evidence of significant interaction occurring between the three independent factors (second order interactions)?
5. Was there any evidence of significant interaction occurring between any two of the independent variables (first order interactions)?

The statistical package used to compute the factorial ANOVA and to answer the five research questions for each age group was the Statistical Package for the Social Sciences, ANOVA Program (Nie and Others, 1975, pp. 398-442). The output from this package was the basis for the information and results which follow.

CHAPTER IV

RESULTS

The purpose of this study was to establish VMI test norms for Tennessee Head Start children by age quartiles. A relatively large set of sample data (3,766 test scores) was utilized in appropriate statistical tests to determine if test norms, which took into account the factors sex, race, and residential location, were needed. The specific question investigated was whether significant differences existed between group's mean VMI test scores when the total sample was grouped into subsamples and analyzed on the basis of sex, race, and residential location. The null hypothesis tested was that no significant differences existed in the average performance of children on the VMI as a result of sex (male or female), race (white or black) or residential location (rural, urban, other).

Acceptance of the null hypothesis would allow one to develop and utilize the same age-quartile norm table for all Tennessee Head Start children. The presently established norms (Beery, and Buktenica, 1967) provide norm data based on sex. The current norms do not take into account differences based on factors such as race, or place of residence. Rejection of the null hypothesis would require VMI age-quartile norm tables developed to appropriately reflect any significant differences found in mean scores due to sex, race, and/or residential location.

Homogeneity of Variance Results

The results of the Bartlett chi square test are presented in the Appendix (Tables A-7, A-8, A-9, and A-10). Comparisons of the calculated Bartlett test statistic and critical chi square values at the .01 level of significance yielded the following results. For three year olds, there was not homogeneity of variance for the factors sex and residence. The calculated B for sex was 16.24 and 25.57 for residence. The critical chi square values were 6.63 and 9.21 for sex and residence respectively. Investigation of the three year old children's scores was dropped due to the rejection of homogeneity of variance on two factors, the possibility of spurious cells, and the fact that three-year olds are very difficult to test reliably on a test of the nature of the VMI.

The result of the Bartlett for four year olds required the rejection of the assumption of equal variances for the factor, race. The calculated B was 21.50 and the critical chi square was 6.63. Both other factors (sex and residence) were found to have homogeneous variance at each level. Although the levels of one factor, race, did not vary homogeneously, the ANOVA procedure was still applied. It was hypothesized that the lack of homogeneity of variance was due to the extremely large sample sizes (1,834 whites and 874 blacks), and further analysis revealed no significant two or three way factor interaction. Also, the scores of the four year olds by race varied consistently.

The application of the Bartlett for five year olds substantiated the assumption of homogeneity of variance for all levels of the three factors at the .01 level of significance.

Three-Way Analysis of Variance Results

Means and standard deviations for the sample studied utilizing a 2 × 2 × 3 factorial ANOVA design are presented separately for the four and five year olds. Interpretation of the ANOVA results was limited to four and five year olds, since the three year olds failed to exhibit homogeneity of variance on two factors and the sample of six year olds was too small for analysis. The results of the ANOVA, which involved analysis for four interactions and three main effects are reported separately by age.

ANOVA Results: Four Year Olds

Means and standard deviations for 2,708 four year old children in the sample are provided in the Appendix (Table A-10). The ANOVA analysis revealed no significant first order (two way) or second order (three way) interactions. The results of this part of the analysis are displayed in Table 1. When no significant interactions were found, the data were examined for significant main effects.

The main effects analysis involved a comparison of the overall VMI means for the levels of sex, race, and residential location. For example, when sex was examined, a comparison was made for significant differences in mean scores between males and females and the other factors were disregarded.

TABLE 1

THREE-WAY ANOVA SUMMARY TABLE FOR VMI MEANS,
FOUR YEAR OLDS

Source	df	MS	F	Level of Significance
Sex (A)	1	12.551	2.778	.092
Race (B)	1	144.015	31.876	.001*
Residence (C)	2	25.170	5.571	.004*
A × B	1	1.501	.332	.999
A × C	2	6.611	1.463	.230
B × C	2	1.616	.358	.999
A × B × C	2	5.077	1.124	.326
Error	2,697	4.518		
Total	2,708			

*Significant at the .01 level.

In Table 1, the reported ANOVA results disclosed significant F values for the main effects of both race and residence. The main effect of the factor, sex, was not shown to be significant, which indicated that there were no significant differences in average VMI mean scores between males and females at the four year old level.

The main effect of the factor race was significant as seen in ANOVA Table 1. The calculated F was 31.876 and was significant at the .001 level. Since the factor consisted of two levels, a multiple comparison test was not necessary and the analysis showed, a significant difference among four year olds on VMI mean scores between black and white children. The VMI mean score for white children (4.75) was greater than the VMI mean score for black children (4.26). The total or overall mean score for all four year olds was 4.59.

The main effect for the factor, residential location, was also significant. The factor as shown in Table 1 had a significant F ratio, but further analysis was necessary to determine at what level or levels significant differences existed.

The Sheffé test (Kirk, 1968, pp. 90-91) was used to determine which level(s) of residence (rural, urban or mixed urban-rural) had the mean scores which were significantly different from the mean scores of another level(s). The significant F value tells us only that at least one of the level means was significantly different from one other level mean. With three factor levels, there are several possible meanings for the significant F ratio. The data displayed in Table 2 provides the information for investigation of the significant main effect of residential location.

TABLE 2

MEAN SCORES FOR THE FACTOR RESIDENTIAL LOCATION, FOUR YEAR OLDS

	Urban	Rural	Mixed Urban-Rural	Total
M	4.71	4.62	4.48	4.57
SD	2.14	1.99	1.97	2.03
N	622	1,269	777	2,708

The empirical results of the Sheffé test for four year olds at the .05 level of significance found the levels of the factor residential location to differ significantly in one way. For both the levels, rural and urban, the means differed significantly from the mean of the third level of residence, mixed urban-rural. No significant differences were found to exist between the rural and urban sample means. The statistical results of the Sheffé are presented in Table 3.

TABLE 3

DIFFERENCES AMONG MEANS FOR RESIDENTIAL LOCATION, FOUR YEAR OLDS

	$\bar{X}$ Mixed Urban-Rural	$\bar{X}$ Rural	$\bar{X}$ Urban
$\bar{X}$ other = 2.518 (n = 777)	-	.637*	.850*
$\bar{X}$ rural = 3.155 (n = 1269)		-	.213
$\bar{X}$ urban = 3.368 (n = 662)			-

*Significant at the .05 level.

ANOVA Results: Five Year Olds

Means and standard deviations for the 1,057 five year old children in the sample are presented in the Appendix (Table A-11).

The ANOVA analysis of the data on five year old children yielded the same results as the analysis of data on the four year old children. There were no significant first or second order interactions. When no interactions among variables were found to be significant, the data were examined for significant main effects. The analysis indicated, as with four year olds, that there were no significant differences in the mean scores of the male and female five year olds on the VMI. The mean score for five year old males was 6.42 and the mean score for females was 6.52. The ANOVA results for the five year olds are found in Table 4.

TABLE 4

THREE-WAY ANOVA SUMMARY TABLE FOR VMI MEANS, FIVE YEAR OLDS

Source	df	MS	F	Level of Significance
Sex (A)	1	4.524	.670	.999
Race (B)	1	183.330	27.168	.001*
Residence (C)	2	56.307	8.344	.001*
A × B	1	.222	.033	.999
A × C	2	3.876	.574	.999
B × C	2	14.223	2.108	.120
A × B × C	2	3.066	.454	.999
Error	1,045	6.748		
Total	1,056			

*Significant at the .01 level.

The two factors, race and residential location, had significant differences between the levels of the factors as presented in Table 4. For the factors race, white children's mean score (6.72) was higher than black children's mean score (5.91). The calculated F ratio was 27.168 and was significant at the .001 level. Since there were only two levels of the factors, sex and race, application of a multiple comparison test was not necessary.

Application of the Scheffé test (Kirk, 1968, pp. 90-91) was necessary to produce the results for the analysis of the residence factor. Although the ANOVA indicates significant difference between one or more levels of the factor at the .001 level of significance, it was not known exactly which level(s) significantly differed from one another. Mean scores based on the factor, residence, for five year olds are presented in Table 5.

TABLE 5

MEAN SCORES FOR THE FACTOR RESIDENTIAL LOCATION, FIVE YEAR OLDS

	Urban	Rural	Mixed Urban-Rural	Total
M	6.74	6.56	6.02	6.47
SD	2.69	2.60	2.61	2.64
N	250	551	256	1,057

The Scheffé analysis revealed that the mean scores of children from rural and urban counties were significantly different from the

mean score of the children who resided in counties classified as mixed urban-rural at the .05 level of significance. The results did not show that the mean scores of urban and rural children differed significantly from each other. The empirical results of the Scheffé analysis are displayed in Table 6.

TABLE 6

DIFFERENCES AMONG MEANS FOR RESIDENTIAL LOCATION, FIVE YEAR OLDS

	$\bar{X}$ Mixed Urban-Rural	$\bar{X}$ Rural	$\bar{X}$ Urban
$\bar{X}$ other = 6.023 (n = 256)	-	.541*	.721*
$\bar{X}$ Rural = 6.564 (n = 551)		-	.180
$\bar{X}$ Urban = 6.744 (n = 250)			-

*Significant at the .05 level.

Norm Table Development

Due to the results of the factorial ANOVA a norm table was developed for four and five year old children utilizing the scores in the sample studied. The findings of the ANOVA procedure suggested the appropriateness of providing norms which took into account the significant differences between the levels of the factors race and residential location.

The mean scores by three month intervals (quartiles) are presented for four and five year olds in Table 7. The table was developed to reflect the differences in mean scores by race and residential location. The urban and rural children's scores were combined at three month intervals since there were no significant differences found between these two group's mean scores. The norm data for the third level of residence, the mixed urban-rural group, are presented separately due to the findings of significant differences between this group's mean score and the urban and rural group's mean scores.

TABLE 7

VMI NORM TABLE, FOUR AND FIVE YEAR OLDS

Age in months	White		Black	
	Mean Raw Score		Mean Raw Score	
	Urban-Rural	Mixed Urban-Rural	Urban-Rural	Mixed Urban-Rural
48-50	4.08	3.81	3.66	3.29
51-53	4.46	3.95	3.89	4.11
54-56	5.03	4.43	4.29	4.28
57-59	5.33	5.54	4.96	4.67
60-62	5.95	6.10	5.41	5.10
63-65	6.64	6.24	5.95	4.46
66-68	7.18	6.89	6.36	6.05
69-71	7.77	7.41	7.54	4.91
n = 3766				

CHAPTER V

DISCUSSION AND CONCLUSIONS

The purpose of this study was to develop VMI norms for the Tennessee Head Start population and to investigate whether certain factors (sex, race and residence) had a significant influence on visual-motor development as measured by the VMI. It was hypothesized that the factors (sex, race, and residential location) would have no significant effect on the mean scores of the children in the sample. The null hypothesis was taken, since the review of the literature on visual motor development as measured by geometric form reproduction, indicated that the results of previous studies were primarily developed from general intellectual measures, limited sample sizes, and samples which lacked control for specific variables such as sex, race, mental ability, socioeconomic level, etc.

The present investigation involved a larger sample than any previous studies found on measurement of visual-motor development, and it also utilized a larger group than the original standardization sample for the VMI (Beery and Buktenica, 1967). Also, the sample used for norming was more representative of the population for whom the norms developed would be applied. This study provided a statistical analysis of three variables which might influence children's performance on the VMI. The norm table developed reflected the differences in subgroup means.

The study involved 3,766 four and five year old children's scores on the VMI. Analysis of 407 three year old children's scores and subsequent norming based on factor influence was not completed since the subgroups did not exhibit homogenity of variance.

Although three year olds were not studied in regard to factor influences, Table A-12 in the Appendix displays the age quartile means for this group with no factors taken into account. The mean scores were provided to enable those testing Tennessee Head Start three year olds to have norms which were based on a sample with the same characteristics as the population. Also, the means were based on a sample of 407. The established VMI norms for three year olds were based on the scores of 28 children (see Appendix, Table A-1). The established VMI norms for three year olds ranged from a raw score of two to three (Beery, 1967, p. 66). The quartile mean raw scores for three year olds developed by the present study ranged from two to three (2.19 to 3.39) also and appear to be similar to the established norms.

Results of the four and five year old ANOVA analysis of mean scores was very interesting. The VMI was normed on the basis of sex, but no indication was given in the technical report (Beery, 1967), for this division process. Also, studies on tests similar to the VMI, such as the Bender (1938), have varied in their reports of significant differences between the sexes (Bensberg, 1952; Dierks and Cushna, 1969; Greensberg and Aishan, 1974; and Smith and Keogh, 1963).

In the present study, however, there were no significant differences found between males and females. There were 1,266 males and 1,443

female four year olds and 527 male and 530 female five year olds. If significant differences between the sexes were to be found on the VMI, one would expect them to be present in a sample of this size. A future study of comparable size dealing with other than low income groups might find that significant differences between the sexes exist for other income groups; however, it is doubtful.

A second factor studied was race. For both four and five year olds, the differences between the mean scores of white and black children were found to be significantly different. Tables A-10 and A-11 (see Appendix) provide the mean scores for four and five year olds by race. For all age quartiles, white children residing in urban and rural counties scored significantly higher than black children residing in counties classified as urban or rural. White children residing in counties classified as mixed urban-rural scored significantly higher than black children living in counties classified mixed urban-rural. This was consistent for all quartiles except for children 51 to 53 months of age. In this quartile, black children scored higher than white children. Also, white children living in the counties classified as mixed urban-rural scored significantly higher than urban and rural blacks. Thus, race as a factor was shown to be significant regardless of county classification with whites scoring higher than blacks.

Table 7, page 44, indicates that, although whites scored significantly higher than blacks, the raw score differences up to age five years (59 months) were less than one point different. This means that white four year olds on the average copied one drawing more than

black four year olds. One could conclude that this is not a large difference in performance, and this researcher would be inclined to agree that such a difference is not large at this age level. The reader should keep in mind, however, that the difference was significant. The probability that special attention should be paid to giving additional opportunities to black children to use manipulative materials and experiences with easel painting, etc. is realistic. Also, care should be taken to involve the parents in the use of such materials with children in the home. It is possible that differential practice and familarity with pencil and paper between blacks and whites is evidenced at four years of age according to the results of the present study.

The five year old blacks and whites exhibited differences in mean scores by quartiles as high as 2.76 points apart as shown in Table 7, page 44. It is possible that differences in performance on the VMI between blacks and whites increase with age. It has also been suggested in the literature that black children may be more developed in the area of gross motor skills due to the effects of modeling. The reader is cautioned at over reacting to the differences in white and black children's performance on the VMI. In conclusion, however, care should be taken to provide adequate visual-motor experiences for this age group (four and five year olds) for both blacks and whites with manipulative materials, which would enhance fine motor development.

Results involving the analysis of the factor, residential location, for four and five year olds were interesting. There was a

significant difference found between the levels of the factor, residence. Rural counties were those with less than 35 percent of their residents living in urban areas (service areas of 50,000 or more or cities or towns of 2,500 or more). Urban counties were those with 65 percent or greater of their residents living in service areas of 50,000 or more or in towns of 2,500 or more. The third level of the factor, residence, was mixed urban-rural, and these counties had greater than 35 percent urban residents but less than 65 percent urban residents.

The analysis did not find significant differences between urban and rural children's mean scores. The mean scores of both urban and rural children were significantly different from the children's mean scores residing in counties classified as mixed urban-rural. In the present study, black children in urban and rural counties scored consistently higher (except in one quartile) than the black children living in the counties classified as mixed urban-rural. Urban and rural white children scored higher in six quartiles and lower in two quartiles than white children residing in counties classified as mixed urban-rural. This information is presented in tabular form in Table 7, page 44.

On the basis of one study, no specific conclusions concerning the effects of residence can be made. The researcher could suggest that children residing in the mixed urban-rural counties are members of families residing near factory towns. This could mean that the parents of these children had less time to spend with the children, if the parents worked irregular shifts. Also, there could be greater deprivation of materials affecting visual-motor development in these fringe areas.

Any such explanation would not be based on any previous studies nor any results found in the present study. The researcher can only suggest that further study of the effect of residential location should be made.

Perhaps, even more important than the differences between black and white children's VMI scores and the differences between urban and rural children's VMI scores as compared with children's VMI scores living in counties classified as mixed urban-rural are the general differences between the norms generated by this study (Table 7, page 44), and the standardized norms (see Appendix, Table A-2).

A question, which the present study, would like to have addressed, was the seemingly rather large difference in average raw scores for four and five year olds in the established VMI norms, and those produced by this study. It was not possible to examine the two sets of norms statistically for significant differences, since the authors of the VMI (Beery and Buktenica, 1967) no longer have the scores and standard deviations for their sample, and the information was not presented in the technical report (Beery, 1967).

The VMI norms are presented in the Appendix (Table A-2), and the norms for the VMI for four and five year olds in this study can be found in Table 7. In comparing the two sets of norms the reader will notice the established norms showed that four year olds should score raw scores of four to seven on the VMI. The four year old Tennessee Head Start children scored between three and five as mean raw scores. The researcher cannot explain if the differences are statistically significant, but four year old Head Start children's mean scores were lower than the established VMI norms for fours.

For five year olds the differences were even more pronounced. Five year old Head Start children, as seen in Table 7, page 44, had mean raw scores which ranged from five to seven. The VMI norms (see Appendix, Table A-2) for five year olds ranged from eight to ten. The ranges on the two sets of norms are seemingly very different. Four and five year old Head Start children's mean scores were lower than the VMI norms. It is possible that middle-class children in the standardization had more opportunities to develop the skills tested by the VMI than the Head Start children.

The screening criteria utilized by the Bill Wilkerson Hearing and Speech Center staff consisted of a system of pass, fail, or teacher alert. If a child did not fail the VMI by scoring more than one year lower than his expected score based on his chronological age, then, he was placed in the teacher alert category. This teacher alert category was developed, since the VMI was administered in a screening situation instead of an actual test situation. Thus, lowering the failure criteria was used to insure that if a child failed the test, it was actual failure and not fear of the tester, lack of time, being put in an unfamiliar situation, etc.

Tennessee Head Start children in the 1975 screening exhibited a 23.9 percent failure rate on the VMI (Appendix, Table A-13). This rate does not include the teacher alert children, who actually failed the VMI. It was calculated that 37 percent of the Head Start children failed the VMI if teacher alerts were included in the failure rate as they should have been, since the established VMI norms were used to

determine if a child passed or failed. Table A-13 (see Appendix) includes numbers and percentages of children who failed only the VMI or were placed in the teacher alert category. Results were not provided on VMI failure if other tests given during the screening (Hearing, Speech, and Language) were also failed. Therefore, Table A-13 (see Appendix) presents a minimal failure rate on the VMI for the Tennessee Head Start sample studied.

Thirty-seven percent is a high percentage of failures, and probably indicates that the VMI established norms are too high or that the Tennessee Head Start children are generally delayed in visual-motor development. The present study cannot completely answer this question, but this researcher feels that the VMI norms are probably somewhat high, and that the Head Start children are somewhat delayed in visual-motor development as measured by the VMI due to the findings of the present study. The reader is reminded of the study cited in Chapter II (p. 21) by Southworth (1973), which found the mean scores of kindergarten children approximately four months below the norms established for the VMI (Beery and Buktenica, 1967). These findings would support the hypothesis that the established VMI norms are generally high for four and five year old children, not just Head Start children.

Suggestions for Further Research

In terms of developing norms for Head Start children, a larger sample than the 3,766 scores used in this study is now available. Head Start children in Tennessee have now been screened on the VMI for

two consecutive years. Also, Kentucky, North Carolina, and Florida Head Start children were screened in 1976. A total of approximately 30,000 Head Start children have been administered the VMI. This data as well as screening data from hearing, speech, and language tests is available for study.

Aside from being concerned with appropriate norm development, since Head Start children did score relatively low on the VMI, further experimental research could be done on general score improvement or specific factors investigated. The residential findings should be studied more closely. What is occurring or not occurring in the mixed urban-rural communities that is causing these children to exhibit significantly different visual-motor development as measured by the VMI in comparison with their urban and rural peers?

Further study concerning the age at which visual-motor development first appears deficient is needed. Head Start children were below the established VMI norms at four and further behind by age five. The reader should keep in mind the questions raised concerning the original norms, the size of the standardization sample, and the characteristics of the sample. Also, the present study's findings concerning the effects of race and residence should be controlled in further studies, and research on the effects of such factors completed. Studies are also necessary to determine if differences based on race, residence, or the effect of socioeconomic level continue to affect visual-motor development after age five or if the effects disappear.

Another question to be considered is, does Head Start, as a program do anything to decrease the differences due to race, residence, or income level if the effects of these factors are significant? Of course, further research with middle and upper income groups would have to be completed first. Studies must be done to determine if significant differences exist on children's VMI scores between different socio-economic levels of the population. Also, these investigations must take into account, such factors as race and residential location, to determine if the scores made on the VMI by children from all income levels are affected equally by these variables.

Other research could involve the study of differences between groups of children and subsequent improvement of the children on visual motor tests, such as the VMI; who are enrolled in Home Start, Home Based, and Center Based Programs, as the three options provided by Head Start funds. These studies could also lead into research on the family as it influences visual motor development.

Questions, which could be investigated, might involve visual-motor development among siblings. Does visual-motor development as measured by the VMI, in regards to passing and failing such tests, occur generally throughout the children of a family? What could be the cause if such differences were found from family to family? Parent involvement is supposed to be a strong component of Head Start. One could research experimentally how this component could be structured to effect and improve visual-motor development. Also, research could be done on the general effects of parent education level and one and

two parent families. Do these variables have any effect on visual-motor development?

The present study only investigated three factors (sex, race, and residence) as affecting visual-motor performance as measured by the VMI. It demonstrated the lack of effect on VMI scores due to sex and the presence of effects due to race and residence. All of these factors need further study, on a more normally distributed sample in terms of income level. Secondly, the study called into question the established VMI norms (Beery and Buktenica, 1967). Finally, the suggestions for further research based on the findings of the present study indicated the need to look at programs available for low income children, and what they are providing to assess and develop visual-motor skills. As with all research, this study is only a beginning of the need for further research.

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TABLE A-1

APPENDIX

NUMBER OF SUBJECTS: 1964 STANDARDIZATION

Age Group	Urban Sample			Suburban Sample			Rural Sample			Grand Total
	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total	
3				18	10	28				28
4				39	20	59				59
5	10	6	16	36	39	75	10	12	22	113
6	15	15	30	27	29	56	6	20	26	112
7	15	13	28	23	21	44	12	7	19	91
8	19	13	32	18	18	36	8	15	23	91
9	13	10	23	25	23	48	11	10	21	92
10	17	14	31	30	23	53	11	7	18	102
11	18	13	31	28	23	51	10	11	21	103
12	13	7	20	30	27	57	10	8	18	95
13	12	19	31	32	27	59	6	9	15	105
14	7	8	15	11	17	28	2	3	5	48
Total	139	118	257	347	277	594	86	102	188	1,039

Source: Beery, K. E. Visual-Motor Integration. Chicago: Follett Educational Corporation, 1967, p. 66.

TABLE A-2

VMI NORM TABLE

Raw Score	Male	Female
1	2-10	2-10
2	3-0	3-0
3	3-2	3-2
4	4-1	3-10
5	4-4	4-1
6	4-6	4-4
7	4-9	4-8
8	5-0	4-11
9	5-3	5-3
10	5-7	5-6
11	6-0	5-10
12	6-5	6-2
13	6-10	6-7
14	7-4	7-2

TABLE A-3

TENNESSEE HEAD START SAMPLE COUNTY CLASSIFICATION

Percent of Population Urban	Urban	Rural	Mixed Urban-Rural
56.1			Anderson
49.0			Bedford
25.2		Benton	
00.0		Bledsoe	
42.2			Blount
50.7			Bradley
26.5		Campbell	
00.0		Cannon	
32.1		Carroll	
36.1			Chester
00.0		Claiborne	
00.0		Clay	
29.0		Cocke	
64.4			Coffee
00.0		Crockett	
26.0		Cumberland	
97.4	Davidson		
00.0		Decatur	
26.9		Dekalb	
00.0		Fayette	
00.0		Fentress	
21.1		Franklin	
50.4			Gibson
31.6			Giles
00.0		Grainger	
28.8		Greene	
00.0		Grundy	
52.5			Hamblen
80.7	Hamilton		
00.0		Hancock	
30.6		Hardin	
29.4		Hawkins	
35.8			Haywood
28.7		Henderson	
41.7			Henry
00.0		Houston	
28.0		Humphreys	
00.0		Jackson	
20.5		Jefferson	

TABLE A-3 (continued)

Percent of Population Urban	Urban	Rural	Mixed Urban-Rural
00.0		Johnson	
68.9	Knox		
00.0		Lake	
23.6		Lauderdale	
30.5		Lawrence	
28.9		Lincoln	
37.3			Loudon
43.8			McMinn
19.0		McNairy	
21.0		Macon	
17.6		Marion	
57.6			Maury
00.0		Meigs	
29.6		Monroe	
00.0		Moore	
0.2		Morgan	
50.3			Obion
20.5		Overton	
00.0		Perry	
00.0		Pickett	
00.0		Polk	
40.2			Putnum
25.4		Rhea	
53.5			Roane
58.7			Rutherford
17.6		Scott	
00.0		Sequatchie	
9.4		Sevier	
00.0		Smith	
00.0		Stewart	
55.8			Sullivan
50.3			Sumner
20.7		Tipton	
00.0		Trousdale	
00.0		Union	
00.0		Van Buren	
39.5			Warren
45.7			Washington
00.0		Wayne	
27.9		Weakley	
28.9		White	

TABLE A-3 (continued)

Percent of Population Urban	Urban	Rural	Mixed Urban-Rural
27.4		Williamson	
33.8		Wilson	

Source: Compiled from U.S. Bureau of the Census, Census of Population. 1970 Detailed Characteristics, Final Report PC (1)-D1, Table 9, Population and Land Area of Counties: 1970 and 1960, Washington, D.C.: USGPO, 1973, pp. 41-15—41-16.

TABLE A-4

TENNESSEE HEAD START SAMPLE BY COUNTY

Programs	Counties	Number of Children Screened
Anderson County	Anderson	19
Caney Fork	Cannon	54
	DeKalb	76
	Warren	96
Chattanooga City	Hamilton	148
Chickasaw	Chester	22
	Decatur	16
	Hardin	32
	Haywood	67
	Henderson	48
	McNairy	25
Cordell Hull	Clay	52
	Jackson	64
	Macon	96
	Smith	61
Douglas Cherokee	Blount	68
	Cocke	37
	Grainger	29
	Hamblen	31
	Jefferson	37
	Monroe	25
	Sevier	40
Elk and Duck	Bedford	38
	Coffee	61
	Franklin	40
	Giles	41
	Lawrence	61
	Lincoln	35
	Maury	26
	Moore	6
	Perry	19
	Wayne	10

TABLE A-4 (continued)

Programs	Counties	Number of Children Screened
Hamilton County	Hamilton	194
Highland Rim	Houston	10
	Humphreys	16
	Stewart	12
Johnson County	Johnson	34
Knoxville City	Knox	179
Knox County	Knox	171
Lau-Fay-Ton	Fayette	59
	Lauderdale	31
	Tipton	63
L.B.J. & C.	Cumberland	59
	Fentress	46
	Overton	51
	Pickett	23
	Putnum	49
	White	28
Mid Cumberland	Rutherford	85
	Sumner	31
	Trousdale	24
	Williamson	33
	Wilson	16
Mid East	Loudon	25
	Roane	40
Mountain Valley	Campbell	50
	Claiborne	102
	Morgan	107
	Scott	60
	Union	37
Nashville	Davidson	318

TABLE A-4 (continued)

Programs	Counties	Number of Children Screened
Northwest	Benton	26
	Carroll	5
	Crockett	18
	Gibson	21
	Henry	12
	Lake	8
	Obion	39
	Weakley	21
Oak Ridge	Anderson	64
Progress for People	Bledsoe	11
	Bradley	55
	Grundy	27
	McMinn	24
	Marion	14
	Meigs	10
	Polk	17
	Rhea	11
	Sequatchie	11
Upper East	Greene	32
	Hancock	49
	Hawkins	63
	Sullivan	200
	Washington	38
Totals: 22	82	4,209

TABLE A-5

TENNESSEE HEAD START SCREENING SAMPLE

Age in Years	Absolute Frequency	Sex		Race		Residential Location		
		Male	Female	White	Black	Rural	Urban	Mixed Urban-Rural
3	407	180	227	262	145	206	87	114
4	2,709	1,266	1,443	1,835	874	1,270	662	777
5	1,057	527	530	733	324	551	250	256
6	36	19	17	26	10	20	11	5
Totals	4,209	1,992	2,217	2,856	1,353	2,047	1,010	1,152

TABLE A-6

INTER-RATER-RELIABILITY STUDY

Screeners	Testers A	Testers B	Testers C	Testers D	Supervisors E	Supervisors F
Testers						
A	-	.90	.91	.90	.91	.89
B	-	-	.89	.89	.90	.88
C	-	-	-	.89	.89	.89
D	-	-	-	-	.90	.88
Supervisors						
E	-	-	-	-	-	.90
F	-	-	-	-	-	-

All possible pairs/Testers	n = 6	.90
All possible pairs/Supervisors	n = 2	.90
All possible pairs Testers/Supervisors	n = 8	.89
All possible pairs	n = 15	.89

TABLE A-7

BARTLETT'S TEST FOR HOMOGENEITY OF VARIANCE,
THREE YEAR OLDS

Factors	Number of Cases	d.f. fi	si^2	B*
SEX	407			16.24*
Males	180	179	3.2232	
Females	227	226	1.8255	
RACE	407			1.12
White	262	261	2.5328	
Black	145	144	2.1655	
RESIDENCE	407			25.57*
Rural	206	205	2.1806	
Urban	87	86	3.9562	
Mixed Urban-Rural	114	113	1.4554	

*Significant at the .01 level.

TABLE A-8

BARTLETT'S TEST FOR HOMOGENEITY OF VARIANCE,
FOUR YEAR OLDS

Factors	Number of Cases	d.f. fi	si^2	B*
SEX	2,708			.87
Males	1,266	1,265	4.2357	
Females	1,442	1,441	4.0253	
RACE	2,708			21.50*
White	1,834	1,833	4.4200	
Black	874	873	3.3592	
RESIDENCE	2,708			5.48
Rural	1,269	1,268	3.9923	
Urban	662	661	4.5788	
Mixed Urban-Rural	777	776	3.9094	

*Significant at the .01 level.

TABLE A-9

BARTLETT'S TEST FOR HOMOGENEITY OF VARIANCE,
FIVE YEAR OLDS

Factors	Number of Cases	d.f. fi	si^2	B*
SEX	1,057			.26
Males	527	526	7.1275	
Females	530	529	6.8171	
RACE	1,057			2.11
White	733	732	7.1192	
Black	324	323	6.1979	
RESIDENCE	1,057			.41
Rural	551	550	6.7918	
Urban	250	249	7.2595	
Mixed Urban-Rural	256	255	6.8230	

*Significant at the .01 level.

TABLE A-10

MEANS AND STANDARD DEVIATIONS FOR VMI SCORES,
FOUR YEAR OLDS

	Race					
	White			Black		
Residence	Rural	Urban	Mixed Urban-Rural	Rural	Urban	Mixed Urban-Rural
SEX						
Male						
M	4.63	5.09	4.47	4.09	4.31	4.11
SD	2.09	2.37	2.02	1.76	1.83	1.92
n	444	175	231	135	153	128
Female						
M	4.85	4.81	4.58	4.31	4.55	4.15
SD	2.03	2.24	2.02	1.71	1.92	1.86
n	525	197	262	165	137	156
Total Cases	2,708					

TABLE A-11

MEANS AND STANDARD DEVIATIONS FOR VMI SCORES,
FIVE YEAR OLDS

	Race					
	White			Black		
Residence	Rural	Urban	Mixed Urban-Rural	Rural	Urban	Mixed Urban-Rural
SEX						
Male						
M	6.62	6.75	6.65	5.39	6.55	5.23
SD	2.64	2.99	2.88	1.92	2.65	2.12
n	239	53	81	36	74	44
Female						
M	6.80	7.33	6.49	5.90	6.57	5.04
SD	2.67	2.38	2.45	2.18	2.71	2.36
n	236	46	78	40	77	53
Total Cases	1,057					

TABLE A-12

VMI QUARTILE MEANS,
THREE YEAR OLDS

Age in Months	Mean Raw Score
36 - 38	2.19
39 - 41	2.55
42 - 45	2.69
45 - 47	3.39

n = 407

TABLE A-13

WILKERSON VMI SCREENING RESULTS

	Number of Children Who Failed Only the VMI	Percent of Population Failing Only the VMI	Number of Teacher Alerts	Teacher Alerts—Percent of Population Failing Only the VMI
Florida	1,197	20.4	1,033	17.6
Kentucky	919	18.8	915	18.7
North Carolina	1,438	32.1	518	11.6
Tennessee	1,337	23.9	736	13.2
Total	4,891	23.8	3,202	15.3

Source: Bill Wilkerson Hearing and Speech Center. Screening results presented at the Region Four, Office of Child Development Conference on "Services to the Handicapped," Atlanta, Georgia, May, 1976.

VITA

Barbara Ann Chervin was born in Knoxville, Tennessee, on December 26, 1951. She attended elementary and junior high schools in that area and was graduated from Fulton High School in 1969. In June of that year, she entered the Uni rsity of Tennessee and received a Bachelor of Science degree in Secondary Education in June of 1973. After working in the Department of Head Start Training at the University of Tennessee, she applied for acceptance and began study in the graduate program of Child and Family Studies. She continued working for the University of Tennessee during her graduate program in her present position as a State Training Officer working with Head Start Programs. In March of 1977, she completed the Master of Science degree in Child and Family Studies.